

BROMOFORM

Bromoform is a federal hazardous air pollutant and was identified as a toxic air contaminant in April 1993 under AB 2728.

CAS Registry Number: 75-25-2

CHBr₃

Molecular Formula: CHBr₃

Bromoform occurs as a colorless-to-yellow heavy liquid or as hexagonal crystals with a chloroform odor and a sweet taste. It is soluble in water and miscible with alcohol, benzene, chloroform, ether, petroleum ether, acetone, and oils. Bromoform gradually decomposes, acquiring a yellow color, especially in the presence of air and light (Merck, 1983).

Physical Properties of Bromoform

Synonyms: tribromomethane; methyl tribromide; methenyl tribromide

Molecular Weight:	252.77
Boiling Point:	149 - 150 °C
Melting Point:	8.3 °C (solidifies at +7.5 °C)
Flash Point:	None
Vapor Density:	8.7 (air = 1)
Density/Specific Gravity:	2.89 at 20/4 °C (water = 1)
Vapor Pressure:	5.4 mm Hg at 25 °C
Log Octanol/Water Partition Coefficient:	2.38
Water Solubility:	3,100 mg/L at 25 °C
Henry's Law Constant:	5.35 x 10 ⁻⁴ atm-m ³ /mol at 25 °C
Conversion Factor:	1 ppm = 10.34 mg/m ³

(Howard 1990; HSDB 1991; Merck 1983; Sax 1987; Sax 1989; U.S. EPA, 1994a)

SOURCES AND EMISSIONS

A. Sources

Bromoform is used as an intermediate in geological assaying and as a solvent for waxes, greases, and oils. It is also used in shipbuilding, aircraft, and aerospace industries and as an ingredient in fire-resistant chemicals and gauge fluid (HSDB, 1991).

Traces of bromoform are likely to be present in swimming pools, municipal waters, and

wastes as a result of chlorination in the presence of naturally occurring bromide ions and humic substances. It is hypothesized that bromoform may be formed by the haloform reaction which occurs during the chlorination of water (Howard, 1990).

B. Emissions

No emissions of bromoform from stationary sources in California were reported, based on data obtained from the Air Toxics “Hot Spots” Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

Marine algae are considered a major natural source of bromoform (Howard, 1990).

AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of bromoform. However, the United States Environmental Protection Agency (U.S. EPA) has compiled information from 14 U.S. urban sites during 1989 that reported a mean concentration of 2.3 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) or 0.22 parts per billion (U.S. EPA, 1993a).

INDOOR SOURCES AND CONCENTRATIONS

No information about the indoor sources and concentrations of bromoform was found in the readily-available literature.

ATMOSPHERIC PERSISTENCE

The major chemical loss processes for bromoform in the troposphere are expected to be by photolysis and reaction with the hydroxyl (OH) radical. No rate constants have been measured for the gas phase reaction with the OH radical, but a rate constant can be determined (Kwok and Atkinson, 1995) which leads to a calculated half-life and lifetime of bromoform due to the reaction with the OH radical of about 240 days and 340 days, respectively (Atkinson, 1995). The calculated half-life and lifetime due to reaction by photolysis is estimated to be about 120 days and 170 days, respectively, for an overhead sun at 15 kilometers altitude (the upper troposphere) (Gillotay et al., 1989). Both processes are slow, with photolysis appearing to dominate.

AB 2588 RISK ASSESSMENT INFORMATION

Bromoform emissions are not reported from stationary sources in California under the AB 2588 program. It is also not listed in the California Air Pollution Control Officers

Association Air Toxics “Hot Spots” Program Revised 1992 Risk Assessment Guidelines as having

health values (cancer or non-cancer) for use in risk assessments (CAPCOA, 1993).

HEALTH EFFECTS

Probable routes of human exposure to bromoform are inhalation, ingestion, and dermal contact.

Non-Cancer: Bromoform is a central nervous system depressant, and its vapors are highly irritating to the eyes and respiratory tract. Limited observations in humans and animal studies indicate that acute inhalation or oral exposure to high levels of bromoform may cause liver and kidney injury. Chronic effects of bromoform exposure in humans have not been studied, although animal studies indicate adverse effects on the liver, kidney, and central nervous system (U.S. EPA, 1994a).

The U.S. EPA is currently reviewing the Reference Concentration (RfC) for bromoform, but has set an oral Reference Dose (RfD) of 0.02 milligrams per kilogram per day, based on hepatic lesions in rats. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in the occurrence of chronic, non-cancer effects (U.S. EPA, 1994a).

No studies were located regarding adverse developmental or reproductive effects of bromoform in humans. Oral exposure in test animals has not resulted in adverse developmental or reproductive effects (U.S. EPA, 1994a).

Cancer: The U.S. EPA reported that the only available human cancer study that suggested a positive correlation between levels of bromoform in drinking water and the incidence of several tumor types, was incomplete because the study design did not consider variables such as personal habits, residential histories, and past exposures. Increased incidences of liver and intestinal tumors were observed in test animals exposed orally to bromoform (U.S. EPA, 1994a).

The U.S. EPA has classified bromoform in Group B2: Probable human carcinogen, with an inhalation unit risk estimate of 1.1×10^{-6} (microgram per cubic meter)⁻¹. In other words, if an individual were to breathe air containing bromoform at $0.9 \mu\text{g}/\text{m}^3$ over an entire lifetime, theoretically that person would have no more than a 1 in 1 million increased chance of developing cancer (U.S. EPA, 1994a). The International Agency for Research on Cancer has classified bromoform in Group 3: Not classifiable as to its potential for carcinogenicity in humans (IARC, 1991a).

The State of California has determined under Proposition 65 that bromoform is a carcinogen (CCR, 1996).

